U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: AIRPORT OBSTACLE ANALYSIS

Date: DRAFT
Initiated By: AFS-400

AC No: 120- OBS-11
Change:

1. PURPOSE. This Advisory Circular (AC) describes acceptable methods and guidelines for developing takeoff and initial climb-out airport obstacle analyses and inflight procedures to comply with the intent of the regulatory requirements of Federal Aviation Regulations (FAR's) Sections 121.177, 121.189, 135.367, 135.379, 135.398 and other associated engine-out requirements relating to turbine engine powered airplanes operated under Parts 121 and 135. The methods and guidelines presented in this AC are neither mandatory nor the only acceptable methods, and operators may use other methods that ensure compliance with the regulatory sections if those methods are shown to provide the necessary level of safety, and are acceptable to the FAA. This AC need not serve as the only sole basis for determining whether an obstacle analysis program meets the intent of the regulations. However, the methods and guidelines described in this AC have been derived from extensive FAA and industry experience and are considered acceptable to the FAA when appropriately used. Mandatory terms used within this AC such as "shall" or "must" are used only in the sense of ensuring applicability of the methods and guidelines when the methods and guidelines described herein are used.

2. FOCUS. This AC applies to operations conducted under FAR part 121, and operations of large transport and commuter category airplanes conducted under FAR part 135, with particular emphasis on transport category turbine and reciprocating engine powered airplanes which meet the certification regulations applicable since August 29, 1959 (SR422B). Airplanes meeting earlier performance requirements or other types of airplanes may use criteria and methods equivalent to those described by this AC, provided they properly account for the performance specified by the Airplane Flight Manual (AFM). Information in this AC may also be used by other operators (e.g., FAR 91 turbojet operators) as applicable to that operator's needs and requirements, as long as the resulting operations are otherwise consistent with applicable FARs.

3. RELATED FAR SECTIONS. FAR Sections 1.1, 25.105, 25.107, 25.111, 25.113, 25.115, part 33, part 77, FAR Sections 91.167, 121.97, 121.141, 121.173, 121.177, 121.189, 121.191, 121.443, 121.445, 135.367, 135.379, 135.381, 135.398, and 152.11.

4. RELATED REFERENCES. Additional information on airport obstacle analysis may be found in the following documents:

a. FAA Documents.

(1) AC 121.445, Pilot-In-Command Qualifications for Special Areas/Routes and Airports, current edition.

(2) FAA Order 8260.38, Civil Utilization of Global Positioning System (GPS), current edition.

(3) FAA Order 8260.40, Flight Management System (FMS) Instrument Procedures Development, current edition.

Documents in paragraph 4a(1), (2), and (3) may be obtained by writing to U.S. Department of Transportation, Subsequent Distribution Office, Ardmore East Business Center, 3341 Q 75th Ave., Landover, MD 20785.

(4) AC 150/5300-13, Airport Design.

(5) FAA Order 8260.3, United States Standard for Terminal Instrument Procedures (TERPS), current edition.

(6) FAA Order 8400.10, Air Transportation Operations Inspector's Handbook.

Documents in paragraph 4a(4), (5), and (6) may be purchased from the following address: New Orders, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954.

b. Other Documents.

(1) International Civil Aviation Organization (ICAO) Annex 4, chapters 3, 4, and 5.

(2) ICAO Annex 6, Part 1.

Documents in paragraph 4b(1) and (2) may be purchased from the following address: ICAO Document Sales Unit, 999 University St., Montreal, Quebec, Canada, H3C 5H7.

(3) Airport/Facility Directory (A/FD). The A/FD may be purchased from the National Ocean Service, N/CG33, Distribution Branch, Riverdale, MD. 20737.

5. BACKGROUND. FAR Sections 121.177, 121.189, 135.367, 135.379, and 135.398 specify required takeoff and performance operating limitations. These limitations include determination of the takeoff flight path that meets specified obstacle clearance requirements (both vertical and horizontal) in the event of an engine failure. FAR Sections 121.189, 135.379, and 135.398 specify AFM compliance and Part 25 provides requirements for establishing the AFM performance data. While the AFM provides detailed instructions for determining the vertical clearance, it offers little guidance on the lateral clearance requirements. The objective of this AC is to provide information for determining safe clearance from obstacles for the actual flight path, and to consider the factors, which may cause a divergence of the actual flight path from the intended flight path. This AC provides guidance and acceptable lateral criteria to assist an operator in developing takeoff procedures and allowable weights for operational use.

6. IMPLEMENTATION. Implementation of this AC may be phased in during a 5-year period after its issuance. The 5-year period was chosen to minimize the implementation burden on the operators' resources and because airport obstacles are normally surveyed on a 5 year cycle. The guidelines in this AC should be used for obstacle analysis as new or revised airport obstacle data are published or when service to a new location begins. It is expected that operators will use the best available data for this implementation and will use any improved data as it becomes available. Airports referenced in AC 121.445, which have been identified because of critical terrain or obstacles, should be given the highest priority. It is strongly recommended that airports referenced in AC 121.445 be reviewed or reanalyzed in accordance with this AC within 2 years of its issuance. The phased implementation of this AC is not meant to discourage operators from completing the implementation at the earliest practical opportunity, if they so desire.

7. SOURCES OF OBSTACLE DATA. Operators are expected to use the best and most accurate available obstacle data for a particular airport at the time of analysis. Data sources do not require specific FAA approval. Operators should be aware that an Airport Obstruction Chart (OC), Type A chart, or any other single source may not include all the pertinent information necessary for doing a takeoff analysis.

8. TERPS CRITERIA VS. ENGINE-OUT REQUIREMENTS:

a. Standard Instrument Departures (SIDS) or departure procedures (DPs) based on U.S. Standards for Terminal Instrument Procedures (TERPS) or ICAO Pans-Ops are based on normal (all-engine) operations. Thus, engine-out obstacle clearance requirements and the all-engine TERPS requirements are independent. Engine-out procedures do not need to meet TERPS requirements. Further, compliance with TERPS climb gradient requirements do not necessarily assure that engine-out obstacle clearance requirements are met. Terminal instrument procedures typically use specified all-engine climb gradients to an altitude, rather than certified engine-out airplane performance. Terminal instrument procedures typically assume a climb gradient of 200 feet per nautical mile (nm) unless a greater gradient is specified. For the purposes of analyzing performance on procedures developed under TERPS or Pans-Ops, it is understood that any gradient requirement, specified or unspecified, will be treated as a plane which must not be penetrated from above until reaching the stated height, rather than as a gradient which must be exceeded at all points in the path. Operators must comply with FAR requirements for the development of takeoff performance data and procedures. There are differences between TERPS and engine-out criteria, including the lateral and vertical obstacle clearance requirements. An engine failure during takeoff is a non-normal condition, and therefore, takes precedence over noise abatement, air traffic, SID's, DPs, and other normal operating considerations.

b. In order for an operator to determine that a departure maintains the necessary obstacle clearance with an engine failure, the operator should consider that an engine failure may occur at any point on the departure flight path.

(1) The most common procedure to maximize takeoff weight when significant obstacles are present along the normal departure route is to use a special engine-out departure routing in the event of an engine failure on takeoff. If there is a separate engine failure departure routing, then the obstacles along this track are used to determine the maximum allowable takeoff weight for that runway.

(2) Consideration must be given to the possibility of an engine failure occurring after passing the point at which the engine-out track diverges from the normal departure track. Judicious selection of this point will simplify the procedure and minimize the difficulty of this analysis. This is generally achieved by keeping the two tracks identical for as far as practicable.

(3) In some cases, two or more special engine-out tracks may be required to accommodate all the potential engine failure scenarios.

(4) Analysis of an engine failure after takeoff may require the use of performance data in addition to that provided in the Airplane Flight Manual. Refer to Section 16. a. (1).

c. When requested by the operators, the FAA may arrange a joint meeting with the operators and other interested parties for discussing all-engine and engine-out requirements at a particular problem airport. Interested parties should include representatives from the Regional Flight Standards Division (RFSD), Certificate Management Organizations (CMO), local and regional Air Traffic Control specialists, Office of Aviation Standards (Flight Procedures and Inspection Division, AVN-200), and affected operators. The operators should bring to the initial meeting a specific departure proposal with alternatives that consider all-engine and engine-out requirements. The operators should attempt to agree on a standard engine-out ground track and the FAA should make every effort to develop the SID, and/or IFR departure procedure to match. The operators should understand that changes to the current SID and/or IFR departure may require a modification in takeoff weather minimums and/or variation in the length of the departure route. Because of the different performance characteristics of various airplanes and airline operational policy, this effort may not result in complete procedure standardization, but it is to the benefit of all parties that the number of unique procedures be minimized.

9. <u>OBSTACLE CONSIDERATIONS</u>:

a. Frangible structures fixed by function with an aeronautical purpose such as antennas, approach lights, and signs need not be considered in an obstacle analysis.

b. Accountability must be made for local temporary or transient obstacles such as ships, cranes, or trains. The clearance height allowances for vehicles above roads, railroads, etc., contained in FAR part 77 and/or on the OC charts shall be used. If the operator has a means to determine the absence of a movable object at the time of takeoff, then it need not be accounted for in the analysis.

c. Reasonable judgment must be used to account for the height of indeterminate objects (objects without recorded height) displayed on topographic maps. Indeterminate objects include such items as trees, buildings, flagpoles, chimneys, transmission lines, etc. The operator needs to use sound judgment in determining the best available data sources when conflicts occur between heights and locations of obstacles in the various sources.

d. If adequate takeoff weights cannot be obtained through the methods of analyses suggested by this AC, an obstacle removal program should be considered. FAR Section 152.11 requires that land grant airports comply with obstacle clearance criteria contained in AC 150/5300-13. In general, these criteria require removal of obstacles that are not required for airport operational safety that are within the "Runway Object Free Area (OFA)" as defined in the referenced AC.

e. Operators should establish an appropriate review cycle to periodically assure the suitability of their performance data and procedures. In addition, operators should evaluate the effect of changes that occur outside of normal information or charting cycles. These changes may occur as a result of issuance of an operationally significant NOTAM, temporary obstacle information, new construction, ATIS procedural constraints, navaid outages, etc. For both periodic reviews and temporary changes, the operator should consider at least the following:

(1) The need for an immediate change versus a routine periodic update.

(2) Use of the best available information.

(3) Any significant vulnerability that may result from the continued use of data other than the most current data, until performance and/or procedures are updated through a routine revision cycle.

(4) Continued suitability of estimates or assumptions used for winds, temperatures, climb gradients, NAVAID performance or other such factors that may affect performance or flight paths.

(5) The review cycles and response times should be keyed to the needs and characteristics of the operator's fleet, routes, airports, and operating environment. No specific time frame is established for an operator to conduct either periodic reviews or short-term temporary adjustments.

10. <u>TERMINATION OF TAKEOFF SEGMENT</u>:

a. For the purpose of the takeoff obstacle clearance analysis, the end of the takeoff flight path is considered to occur when either:

(1) The airplane has reached the minimum crossing altitude (MCA) at a fix, or the minimum enroute altitude (MEA) for a route to the intended destination, or

(2) The airplane is able to comply with enroute obstacle clearance requirements (FAR 121.191, 121.193, 135.381, 135.383), or

(3) The airplane has reached the minimum vectoring altitude, or a fix and altitude, from which an approach may be initiated to the departure airport or departure alternate.

b. When determining the limiting takeoff weight, the obstacle analysis should be carried out to the end of the takeoff segment as defined in paragraph 10a above. Operators should note that the end of the takeoff segment is determined by the airplane's gross flight path but the obstacle analyses must use the net flight path data.

c. In the event that the airplane cannot return to and land at the departure airport, the takeoff flight path should join a suitable en route path to the planned destination or to another suitable airport. It may be necessary to address extended times and alternate fuel requirements when climbing in a holding pattern with reduced climb gradients associated with engine-out turns.

11. METHODS OF ANALYSIS. FAR Sections 121.189, 135.398, and 135.379 require that the net takeoff flight path clears all obstacles by either 35 feet vertically or 200 feet laterally inside the airport boundary, or 300 feet laterally outside the airport boundary. To ensure the required lateral clearance, the operator must account for factors that could cause a difference between the intended and actual flight paths and between their corresponding ground tracks. For example, it cannot be assumed that the ground track coincides with the extended runway centerline without considering such factors as wind and available course guidance (reference paragraph 14). This AC will focus on two methods that may be used to identify and ensure clearance of critical obstacles. These are the "area analysis method" and "flight track analysis method." The two methods may be used in conjunction with each other on successive portions of the analysis. For example, an operator may choose to use an area analysis for the initial portion of the takeoff analysis, followed by a flight track analysis, and then another area analysis.

a. The “area analysis method” defines an obstacle accountability area (OAA) within which all obstacles must be cleared vertically. The OAA is centered on the intended flight track and is acceptable for use without accounting for factors that may affect the actual flight track relative to the intended track, such as wind and available course guidance.

b. The “flight track analysis method” is an alternative means of defining an OAA based on the navigational capabilities of the aircraft. This methodology requires the operator to evaluate the effect of wind and available course guidance on the actual ground track. While this method is more complicated, it can result in an area smaller than the OAA produced by the “area analysis method.”

12. AREA ANALYSIS METHOD:

a. During straight-out departures or when the intended track or airplane heading is within 15° of the extended runway centerline heading, the following criteria apply:

(1) The width of the OAA is 0.0625D feet on each side of the intended track (where D is the distance along the intended flight path from the end of the runway in feet), except when limited by the following minimum and maximum widths.

(2) The minimum width of the OAA is 200 feet on each side of the intended track within the airport boundaries, and 300 feet on each side of the intended track outside the airport boundaries.

(3) The maximum width of the OAA is 2,000 feet on each side of the intended track.
Note: See Appendix 1, Figure 1.

b. During departures involving turns of the intended track or airplane heading of more than 15° from the extended runway centerline heading, the following criteria apply:

(1) The initial straight segment, if any, has the same width as a straight-out departure.

(2) The width of the OAA at the beginning of the turning segment is the greater of:

(i) 300 feet on each side of the intended track.

(ii) The width of the OAA at the end of the initial straight segment, if there is one.

(iii) The width of the end of the immediately preceding segment, if there is one, analyzed by the flight track analysis method.

(3) Thereafter in straight or turning segments, the width of the OAA increases by 0.125D feet on each side of the intended track (where D is the distance along the intended flight path from the beginning of the first turning segment in feet), except when limited by the following maximum width.

(4) The maximum width of the OAA is 3,000 feet on each side of the intended track.
Note: See Appendix 1, Figure 2.

c. The following apply to all departures analyzed with the area analysis method:

(1) A single intended track may be used for analysis if it is representative of operational procedures. For turning departures this implies the bank angle is varied to keep a constant turning radius with varying speeds.

(2) Multiple intended tracks may be accommodated in one area analysis by increasing the OAA width accordingly. In a turn, the specified OAA half-widths (i.e., one-half of the OAA maximum width) should be applied to the inside of the minimum turn radius and the outside of the maximum turn radius. An average turn radius may be used to calculate distances along track.

(3) The distance to an obstacle within the OAA should be measured along the intended track to a point abeam the obstacle.

(4) When the area analysis method is used, the operator is not required to account for crosswind, instrument error or flight technical error within the OAA.

(5) Obstacles prior to the end of the runway need not be accounted for, unless a turn is made prior to the end of the runway.

(6) One or more turns of less than 15° each, with an algebraic sum of not more than a 15° change in heading or track may be analyzed as a straight-out departure.

(7) No accountability is required for the radius of turn or gradient loss in the turn for a turn of 15° or less change in heading or track.

13. <u>FLIGHT TRACK ANALYSIS METHOD.</u> The flight track analysis method involves analyzing the ground track of the flight path. This paragraph discusses factors, which must be considered in performing a flight track analysis.

a. <u>Pilotage in Turns</u>. The ability of a pilot to initiate and maintain a desired speed and bank angle in a turn must be considered. Assumptions used here must be consistent with pilot training and qualification programs.

b. <u>Winds</u>.

(1) When using the flight track analysis method and course guidance is not available, winds which may cause the airplane to drift off the intended track must be taken into account.

(2) The effect of wind on the takeoff flight path should be taken into account, in addition to making the headwind and tailwind component corrections to takeoff gross weight used in a straight-out departure.

(3) When assessing the effect of wind on a turn, the wind may be held constant in velocity and direction throughout the analysis unless known local weather phenomena indicate otherwise.

(4) If wind gradient information is available near the airport and flight path (e.g., wind reports in mountainous areas adjacent to the flight path), the operator should take that information into account in development of a procedure.

14. COURSE GUIDANCE. Credit may be taken for available course guidance when calculating the lateral location of the actual flight track relative to the intended track as part of a flight track analysis.

a. Allowance for Ground Based Course Guidance.

(1) When ground based course guidance is available for flight track analysis, the following nominal allowances may be used, unless the operator substantiates allowances for specific navigational aids at a particular airport:

LOC - plus/minus 1.25° splay with minimum half-width of 300 feet. (Minimum width governs up to 2.25 nm from LOC).

VOR - plus/minus 3.5° splay with minimum half-width of 600 feet. (Minimum width governs up to 1.6 nm from VOR).

ADF - plus/minus 5° splay with minimum half-width of 1,000 feet. (Minimum width governs up to 1.9 nm from ADF).

DME FIX - plus/minus 1 minimum instrument display increment but not less than plus/minus 0.25 nm.

DME ARC - plus/minus 2 minimum instrument display increments but not less than plus/minus 1 nm.

NOTE: The above splays originate from the navigation facility.

(2) These allowances account for crosswind, instrument error, flight technical error, and normal NAVAID signal inaccuracies. Further allowances should be made for known signal anomalies (see Airport/ Facility Directory).

(3) Ground based course guidance may be used in combination with other forms of course guidance to construct a departure procedure.

b. Allowance for Airplane Based Area Navigation Capabilities.

(1) Airplane based area navigation refers to a system (e.g., FMS, RNAV, RNP, IRS, GPS) that permits airplane operations on any desired course, including a turn expansion for fly-by or fly-over waypoints, within the coverage of (ground or space based) station reference navigation signals or within the limits of self contained system capabilities without direct course guidance from a ground based NAVAID. The credit and consideration given to each system will depend on its accuracy, redundancy, and usability under engine-out conditions.

(2) The minimum allowance is the demonstrated accuracy of the airplane based navigation equipment (or the appropriate value for RNP, if RNP is used), but not less than a half-width of 300 feet.

(3) Airplane based course guidance may be used in combination with other navigational course guidance to construct a departure procedure.

c. Allowance for Visual Course Guidance:

(1) Visual ground reference navigation is another form of course guidance. However, to take advantage of visual course guidance, a flight track analysis must be performed.

(2) The ability to laterally avoid obstacles by visual reference can be very precise, if the obstacles can be seen and are apparent. It is the operator's responsibility to ensure the weather conditions, including ceiling and visibility at the time of operation, are consistent with the use of the visual ground reference points for navigation upon which the obstacle analysis is based.

(3) To take advantage of visual course guidance, the flight crew must be able to continuously determine and maintain the correct flight path with respect to ground reference points so as to provide a safe clearance with respect to obstructions and terrain.

(i) The procedure must be well defined with respect to ground reference points so that the track to be flown can be analyzed for obstacle clearance requirements.

(ii) An unambiguous written and/or pictorial description of the procedure must be provided for crew use.

(iii) The limiting environmental conditions (wind, ceiling, visibility, day/night, ambient lighting, obstruction lighting, etc.) must be specified for the use of the procedure to ensure the flight crew is able to visually acquire ground reference navigation points and navigate with respect to those points.

(iv) The procedure must be within the engine-out capabilities of the airplane with respect to turn radius, bank angles, climb gradients, effects of winds, cockpit visibility, etc.

(4) When visual course guidance is used for flight track analysis, the following minimum allowances (in addition to turn radius) will apply:

(i) If the obstacle itself is the reference point being used for visual course guidance, the minimum allowance is 300 feet for lateral clearance from that obstacle.

(ii) When following a road, railroad, river, valley, etc., for course guidance, the minimum allowance is 1,000 feet each side of the width of the navigation feature. This width should include the meandering and/or curves of the navigation feature being used or the definable center of the valley or river.

(iii) When using a lateral visual reference point to initiate a turn, the minimum allowance is plus/minus 0.25 nm along the track at the turn point.

(iv) When initiating a turn directly over a visual reference point, the minimum allowance is plus/minus 0.50 nm along the track at the turn point.

(v) When initiating a turn to avoid overflight of a visual reference point, the minimum allowance is plus/minus 1 nm along the track at the turn point.

(5) Visual course guidance may be used as part of an IFR procedure (e.g., SID, DP) or in conjunction with IFR flight during that portion of the operation which is in visual meteorological conditions (VMC). The visual course guidance may be used in combination with other forms of course guidance to construct an engine-out departure procedure.

15. ANALYSIS OF TURNS:

a. Temperature Effects on Turns. Temperature usually has a very large effect on turn radius. First, the turn radius is a function of true airspeed (plus wind), which varies with temperature at the same indicated airspeed. Second, the engine-out indicated airspeed (V2 or V2 plus an increment) varies considerably with weight, and limit weight is strongly affected by temperature. The temperature effect on both the maximum and minimum turn radii must be taken into account. However, it is acceptable to do a turn analysis based on a single critical temperature if that temperature produces results which are conservative for all other temperatures.

b. Bank Angle. FAR Sections 121.189, 135.379 and 135.398 assume that the airplane is not banked before reaching a height of 50 feet, and that thereafter, the maximum bank is not more than 15 degrees. Obstacle clearance at certain airports can be enhanced by the use of bank angles greater than 15°. The following bank angles and heights may be used with Operation Specification authorization (in accordance with FAR 121.173 (f)). Any bank angles greater than the values shown below require additional specific FAA authorization:

Maximum Bank Angles

Height (above Departure End of Runway - ft)	Maximum Bank Angle (degrees)
h>400	25
400≥h>100	20
100≥h>50*	15

* = Or 1/2 of wingspan, whichever is higher

(1) The AFM generally provides a climb gradient decrement for a 15° bank. For bank angles less than 15°, a proportionate amount of the 15° value may be applied, unless the manufacturer or AFM has provided other data. Bank angles over 15° require additional gradient decrements.

(2) If bank angles of more than 15° are used, V_2 speeds may have to be increased to provide an equivalent level of stall margin protection and adequate controllability, i.e., V_{MCA} (minimum control speed, air). Unless otherwise specified in the AFM or other performance or operations manuals from the manufacturer, acceptable adjustments to ensure adequate stall margins and gradient decrements are provided by the following:

Bank Angle Adjustments

Bank Angle	**Speed**	**'G' Load**	**Gradient Loss**
15°	V_2	1.035	AFM 15° Gradient Loss
20°	V_2+XX/2	1.064	Double 15° Gradient Loss
25°	V_2+XX	1.103	Triple 15° Gradient Loss

Where 'XX' is the all-engine operating speed increment (usually 10 or 15 knots)

NOTE: On some airplanes, the AFM standard V-speeds may already provide sufficient stall margin protection without additional adjustments.

(3) Bank angles over 25° may be appropriate in certain circumstances but require specific evaluation and FAA Certificate Holding District Office (CHDO) approval.

(4) Accountability for speed increase for bank angle protection may be accomplished by increasing V-speeds by the required increment shown above or by accelerating to the increment above V_2 after liftoff. The following are examples of acceptable methods:

(i) If available, AFM data for "improved climb" or "overspeed" performance may be used to determine weight decrements for the desired increase to V_1, V_R, and V_2.

(ii) Calculate a weight decrement from the weight/V-speed relationship in the AFM for the desired increase in V_1, V_R, and V_2.

(iii) Account for the acceleration above V_2 by trading the climb gradient for speed increase. Integrate this climb gradient loss over the distance required to accelerate to determine an equivalent height increment to be added to all subsequent obstacles.

(5) Gradient loss in turns may be accounted for by increasing the obstacle height by the gradient loss multiplied by the flight path distance in the turn, in order to arrive at an equivalent obstacle height that can be analyzed as a "straight-out" obstacle in the operator's airport analysis programs.

(6) For bank angles greater than 15 degrees, the 35 foot obstacle clearance relative to the net takeoff flight path should be determined from the lowest part of the banked airplane.

16. ADDITIONAL CONSIDERATIONS:

a. Airplane Flight Manual Data:

(1) Unless otherwise authorized, AFM data must be used for engine-out takeoff analysis. It is recognized that many AFM’s generally contain only the engine-out performance for loss of an engine at V_1 on takeoff. All-engine performance must also be considered to determine the airplanes flight path in the event of an engine failure at a point on the flight path after V_1. The best available all-engine data should be used consistent with best engineering practices. This data may be found in sources such as community noise documents, performance engineers handbook, flight characteristics manual, manufacturers’ computer programs, etc.

(2) Certain airports may present situations outside the boundaries covered by the AFM. AFM data may not be extrapolated without an authorizing deviation specified in FAR Sections 121.173(f) and 135.363(h). Application for such deviation, with supporting data, should be forwarded to AFS-1, through the POI at the FSDO or CMO.

b. Acceleration and Cleanup Altitudes:

(1) For standardization of operating procedures, many operators select a standard cleanup altitude that is higher than that required for obstacle clearance at most airports. With the standard cleanup altitudes, the acceleration and cleanup may be accomplished within the takeoff thrust time limit established in the AFM. The obstacle analysis is usually based on a level off for cleanup, but, there is no operational requirement to level off, except in the rare case of a distant obstacle, which must be cleared in the final segment. Obstacle clearance margins usually are improved by continuing the climb during cleanup.

(2) The terrain and obstacles at certain airports may require a higher than standard cleanup altitude to be used and may still allow acceleration and cleanup to be accomplished within the takeoff thrust time limit.

c. Confirmation Flights:

(1) Consideration should be given to conducting a flight to confirm flight crews’ ability to fly actual special engine-out departures and to uncover any potential problems associated with those procedures, if they differ significantly from the all-engine procedures, or if terrain makes course guidance questionable at the engine-out altitudes. It should be emphasized that the purpose of this flight is not to prove the validity of the performance data, nor to demonstrate obstacle clearance. In addition, cockpit workload considerations and minimum control speed characteristics are best evaluated in a simulator. Prior experience gained by another airplane type and/or operator may provide sufficient

confirmation of the procedure.

(2) A confirmation flight with a simulated engine failure at V_1 is not recommended. Acceptable techniques used for these flights include:

(i) Initiating the procedure from a low pass over the runway at configurations, speeds, and altitudes that represent takeoff conditions.

(ii) Using a power setting on all engines calculated to give a thrust/weight ratio representative of engine-out conditions or setting one engine to flight idle.

17. PILOT INFORMATION. The development and implementation of unique departure and go around procedures should be coordinated with the Flight Operations department. Flight Crews must receive instructions, through an appropriate means, regarding these procedures. Based on complexity, this could be done through Flight Operations Bulletins, revisions to selected Flight Crew manuals, takeoff charts, Notams or special ground or simulator training.

The operator should advise flight crews of the following: (This may be accomplished as a general policy for all airports with exceptions stated as applicable, or specified for each airport).

a. How to obtain V-speeds consistent with the allowable weights, with particular attention given to the effects of wind, slope, Improved Climb Performance, and contaminants.

b. The intended track with an engine failure. (Some operators have a standard policy of flying runway heading after an engine failure; others routinely assume the all-engine ground track unless specifically stated otherwise. In any case, the intended track should be apparent to the flight crew, and the failure at any point along the track should be taken into account.

c. Speeds (relative to V_2) and bank angles to be flown -- all-engines and engine-out.

d. The points along the flight path at which the flap retraction sequence and thrust reduction are to be initiated.

e. Initial turns should be well defined. ("Immediate" turns should be specified with a minimum altitude for initiation of the turn or a readily identifiable location relative to the runway or navigational fix).

18. MISSED APPROACHES.

a. General

(1) FAR parts 121 and 135 do not specifically require an obstacle clearance analysis for engine-out missed approaches or rejected landings. While it is not necessary to perform such an analysis for each flight, dispatch, or landing weight limitation, it is appropriate to provide information to the flight crews on the safest way to perform such a maneuver should it be required. The intent is to identify the best option or options for a safe lateral ground track and flight path to follow in the event that a missed approach, balked landing, rejected landing or go-around is necessary. To accomplish this, the operator may develop the methods and criteria for the analysis of engine-out procedures which best reflect that operator's operational procedures.

(2) Generally, published missed approach procedures provide adequate terrain clearance; however, further analysis may be required in the following circumstances:

(i) Published missed approach has a climb gradient requirement; or

(ii) Departure procedure for the runway has a published minimum climb gradient; or

(iii) A special engine-out takeoff procedure is required.

(iv) Runways that are used for landing but not for takeoff.

(3) A distinction needs to be made between a missed approach and a rejected landing. An engine-out missed approach from the minimum descent altitude (MDA (H)), decision altitude (height) (DA (H)), or above, can frequently be flown following the published missed approach procedure. A rejected landing from a lower altitude may require some other procedure (e.g., following the same engine-out procedure as used for takeoff). In any case, the pilot should be advised of the appropriate course of action when the published missed approach procedure cannot be safely executed.

b. Assessment Considerations:

(1) Operators may accomplish such assessments generically for a particular runway, procedure, aircraft type, and expected performance, and need not perform this assessment for each specific flight. Operators may use simplifying assumptions to account for the transition, reconfiguration, and acceleration distances following go-around (e.g., use expected landing weights, anticipated landing flap settings).

(2) The operator should use the best available information or methods from applicable aircraft manuals or supplementary information from aircraft or engine manufacturers. If performance or flight path data are not otherwise available to support the necessary analysis from the above sources, the operator may develop, compute, demonstrate or determine such information to the extent necessary to provide for safe obstacle clearance.

(3) The operational considerations should include:

(i) Go-around configuration transitions from approach to missed approach configuration including expected flap settings and flap retraction procedures.

(ii) Expected speed changes.

(iii) Appropriate engine failure and shutdown (feathering if applicable) provisions, if the approach was assumed to be initiated with all engines operative.

(iv) Any lateral differences of the missed approach flight path from the corresponding takeoff flight path.

(v) Suitable balked landing obstacle clearance, until reaching instrument approach missed approach or enroute procedurally protected airspace.

(vi) Any performance or gradient loss during turning flight

(vii) Methods used for takeoff analysis, (such as improved climb), engine-out maximum angle climb, or other such techniques, may be used.

(viii) Operators may make obstacle clearance assumptions similar to those applied to corresponding takeoff flight paths in the determination of net vertical flight path clearance or lateral track obstacle clearance.

c. Assessment Conditions for Balked Landing

(1) A "balked landing" starts at the end of the touchdown zone (TDZ).

(i) A touchdown zone (TDZ) typically is considered to be the first one-third of the available landing distance or 3000' feet, whichever is less. When appropriate for the purposes of this provision, operators may propose to use a different designation for a touchdown zone. For example, alternate consideration of a touchdown zone (TDZ) may be appropriate for runways that:

(a) Are less than 6000' in length and which do not have standard TDZ markings.

(b) Short runways requiring special aircraft performance information or procedures for landing.

(c) Runways for STOL aircraft, or

(d) Runway where markings or lighting dictate that a different TDZ designation would be more appropriate.

(2) An engine failure occurs at the initiation of the balked landing, from an all-engine configuration.

(3) Balked landing initiation speed $\geq V_{REF}$ or V_{GA} (as applicable).

(4) Balked Landing initiation height is equal to the specified elevation of the TDZ.

(5) Balked landing initiation configuration is normal landing flaps and gear down.

(6) At the initiation of the maneuver, all engines are at least in a spooled configuration.

d. <u>"One-Way "Airports or Other Special Situations:</u>

(1) Where obstacle clearance is determined by the operator to be critical, such as for:

(i) Airports in mountainous terrain that have runways that are used predominantly for landing in one direction and takeoff in the opposite direction ("One way in" and "opposite way out"), or

(ii) Runways at which the planned landing weight is greater than the allowed takeoff weight.

(2) The operator should provide the following guidance to the flight crew:

(i) The flight path that provides the best ground track for obstacle clearance.

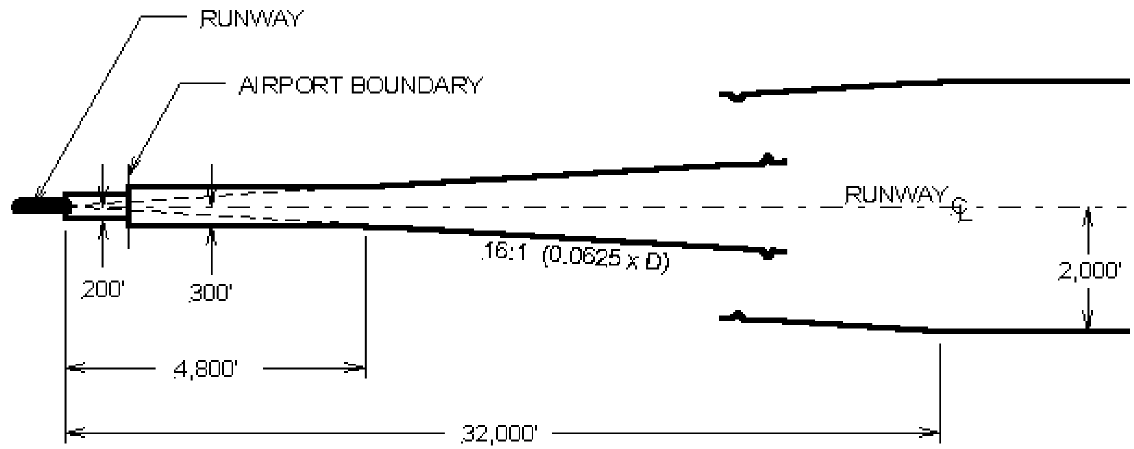
(ii) The maximum weight(s) at which a safe missed approach or rejected landing can safely be accomplished under various conditions of temperature, wind, and aircraft configuration.

(iii) A "commit point" beyond which a safe rejected landing cannot be assured. This should only be used where it is not otherwise possible to identify a safe go-around procedure.

19. <u>ALTERNATE MEANS.</u> The methods and guidelines presented in this AC are not the only acceptable methods. An operator, who desires to use an alternate means, should submit an application to the Certificate Holding District Office (CHDO). The application should describe the alternate assumptions, methods, and criteria to be used along with any other supporting documentation. The CHDO will forward the application through the FSDO (CMO/CMU) to the Director, Flight Standards Service, AFS-1, for review and approval, if appropriate.

Nick Lacey
Director, Flight Standards Service

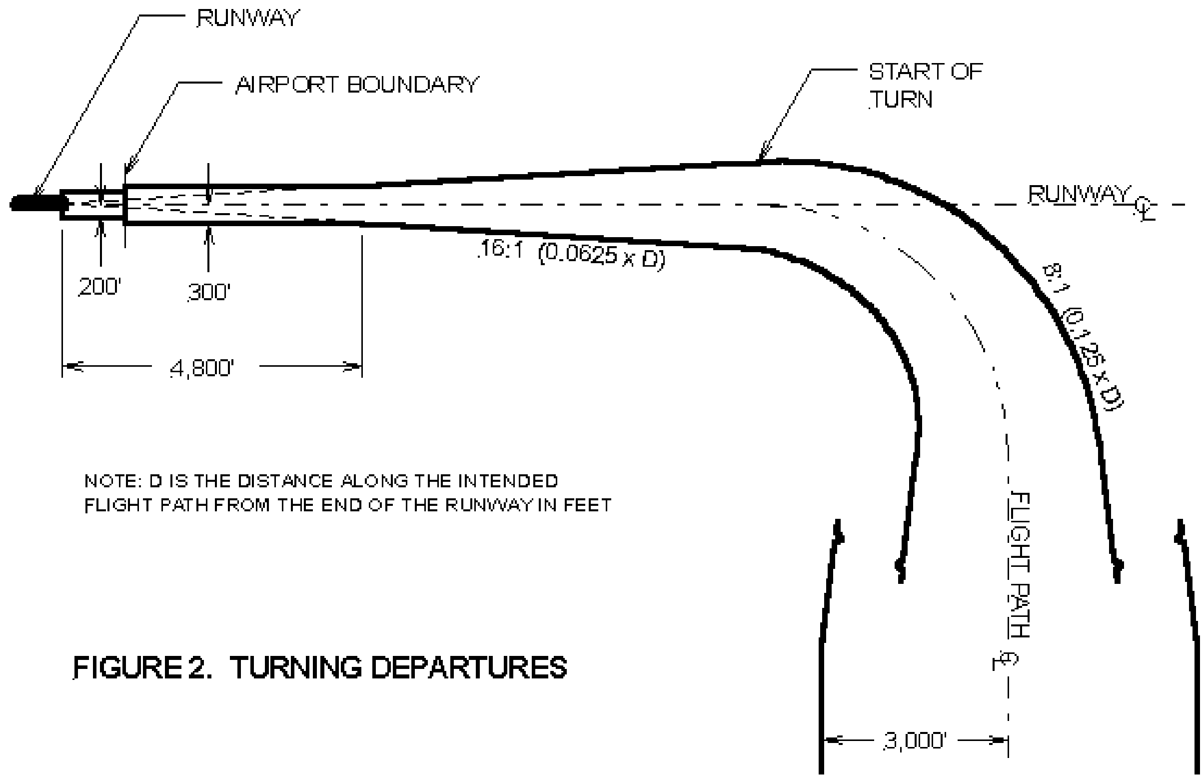
APPENDIX 1. OBSTACLE ACCOUNTABILITY AREA



NOTE: D IS THE DISTANCE ALONG THE INTENDED
FLIGHT PATH FROM THE END OF THE RUNWAY IN FEET

FIGURE 1. STRAIGHT-OUT DEPARTURES

APPENDIX 1. OBSTACLE ACCOUNTABILITY AREA



NOTE: D IS THE DISTANCE ALONG THE INTENDED FLIGHT PATH FROM THE END OF THE RUNWAY IN FEET

FIGURE 2. TURNING DEPARTURES